Estimating Perennial and Non-perennial Stream and River Length in 12 Western States

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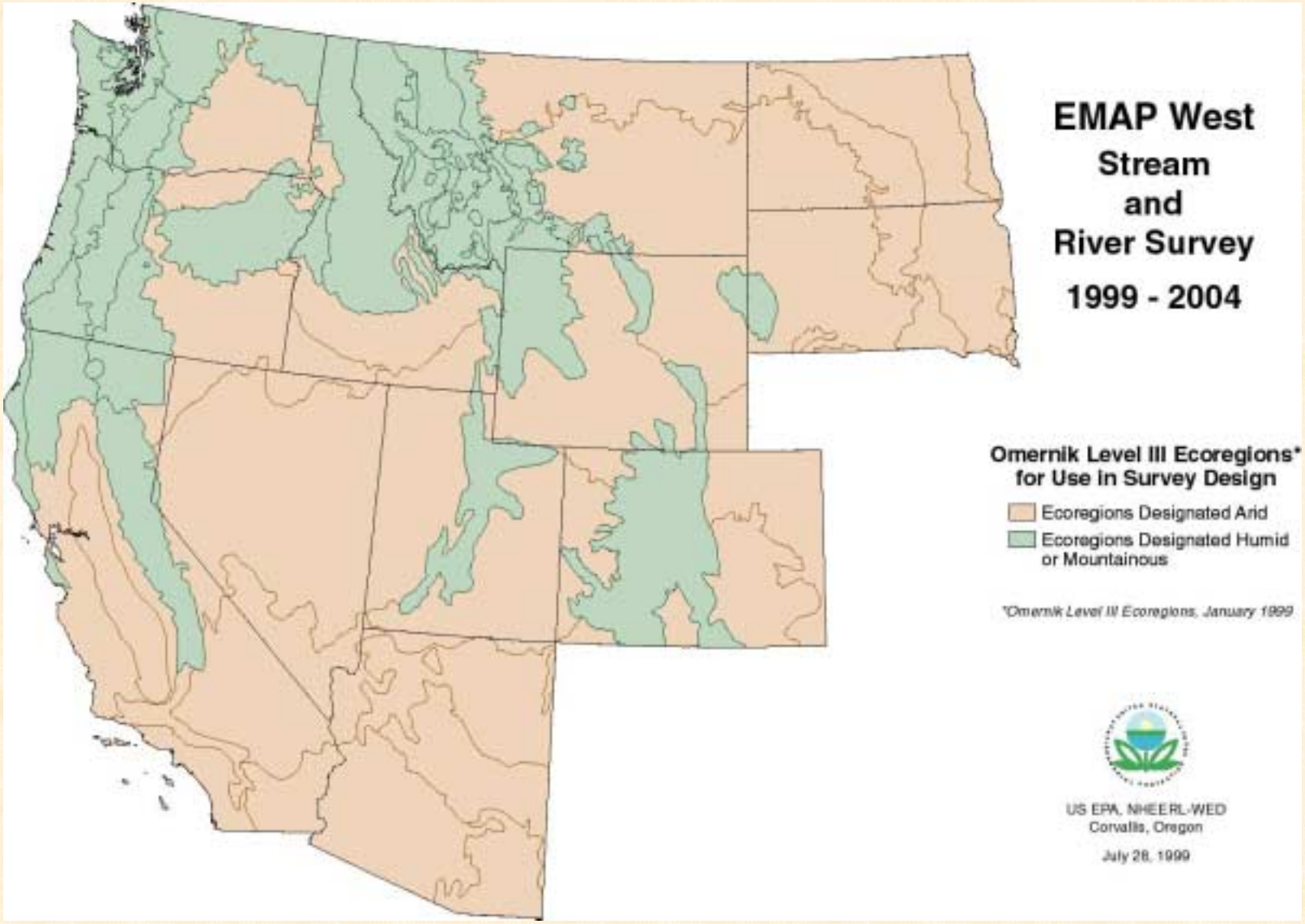
EMAP-West Stream/River Survey Design Objectives

- Estimate for each State, EPA Region, and Study Region
  - Extent (total length) of perennial and non-perennial streams and rivers
  - Condition of perennial streams and rivers
- Estimate for each special study area
  - Extent of perennial streams and rivers
  - Condition of perennial streams and rivers

Survey Design Structure

- Target population: perennial streams excluding "Great Rivers"
  - Mainstem Missouri, Lower Colorado, Columbia, Lower Snake
- Stratify site selection by State
- Unequal probability sampling
  - Strahler order classes
  - Ecoregions ("arid" vs. "humid")

Study Area


EMAP West
Stream
and
River Survey
1999 - 2004
Omernik Level III Ecoregions*
for Use in Survey Design
Ecoregions Designated Arid
Ecoregions Designated Humid
or Mountainous
*Omernik Level III Ecoregions, January 1999
US EPA, NHEERL-WED
Corvallis, Oregon
July 28, 1999

Sample Frame for Streams

- GIS coverage of 1:100,000 stream and river traces contained in RF3 from 12 western states
  - NHD was not yet available (1999)
- RF3 factors used in design
  - Code for perennial and non-perennial
  - State and special study areas
  - Strahler order – added by EMAP
  - Omernik ecoregion – added by EMAP
- RF3 known to have inaccurate codes
  - Mapping errors
  - Scale (1:100,000)
  - Photo interpretation, date of photo

Site Evaluation Study

- 1999: set stage for selection of field sampling sites in 2000—2003
- Survey of RF3 reaches
  - Evaluated using independent approaches
- Estimate extent of "differences" in RF3 coding
  - Better estimates of total stream length for more accurate extent estimates
    - What is included that shouldn't be?
    - What is not included that should be?
  - Minimize wasted visits and other "surprises"

Participants and Acknowledgements

- Arizona DEQ
- California DFG
- Idaho DEQ
- Montana DEQ
- N. Dakota DOH
- Oregon DEQ
- S. Dakota DNR
- Washington DOE
- Dynamac, Inc.

- 100s of local experts from all 12 States
- Barb Rosenbaum (Indus, Inc.) – frame development
- Dave Cassell (CSC) – Statistical support for site selection and estimation

Two Surveys

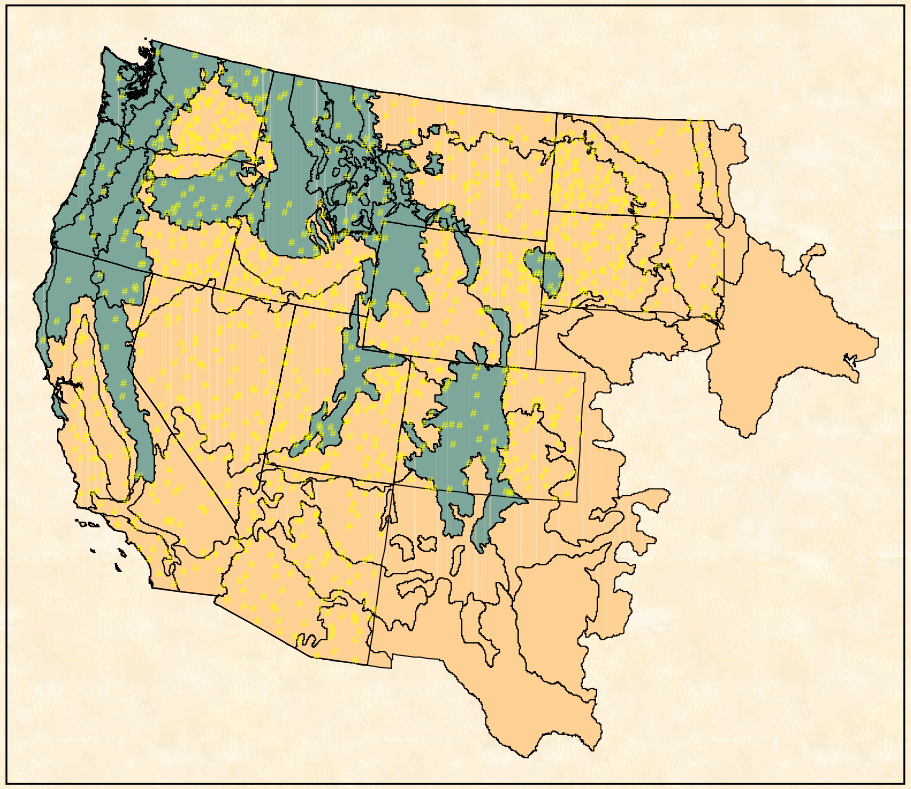
- RF3 Non-perennial Survey
  - Selected from RF3 reaches coded as "non-perennial"
    - Excludes large non-perennial rivers
  - 100 "sites" per state
    - site = lat/long coordinates
  - All sites were evaluated
- RF3 Perennial Survey
  - Selected from RF3 reaches coded as "perennial"
    - Includes large rivers coded as non-perennial
  - Evaluate enough sites to end up with at least 50 per state
    - *n* ranged between 78 and 384 sites

Site Evaluation Process

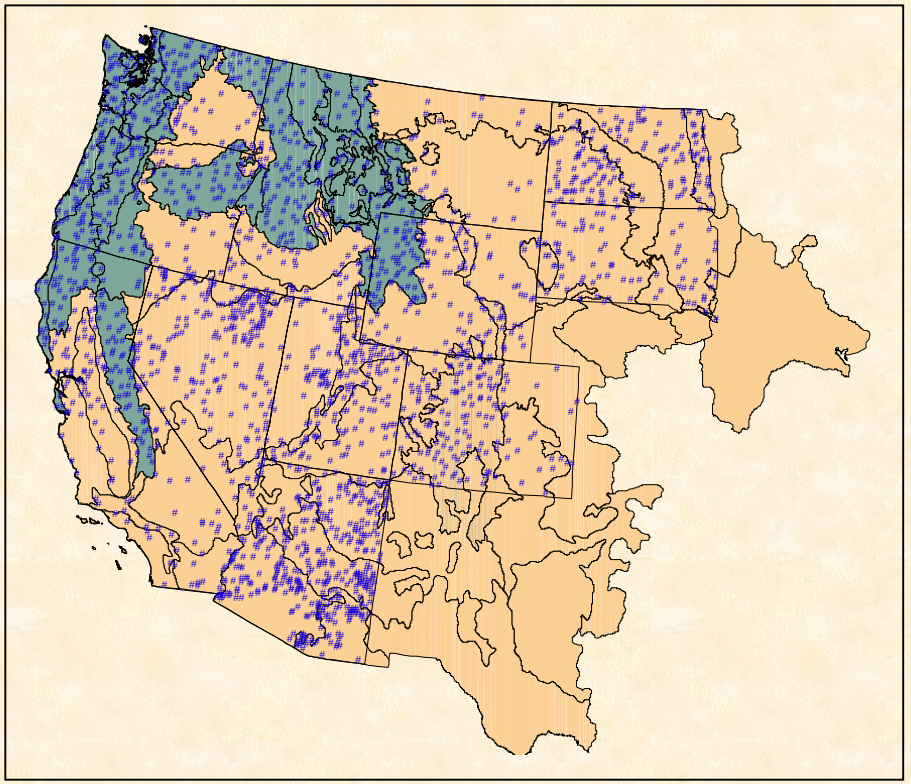
- Each site evaluated to determine
  - Stream channel existence
  - Perennial or non-perennial
    - "perennial" = flow all year most years
  - Other characteristics
- Standardized procedures and data forms
  - Office
    - Maps
    - Aerial photographs
    - Phone calls/local experts
    - GIS coverages
  - Field visit (if no information from office)
    - Drive by or actually visit a site for confirmation

Site Locations

Nonperennial Survey



Perennial Survey



Data Analysis

- Defining and classifying the "target population"
  - "Perennial": Candidate site; potentially part of target population for EMAP Western Pilot
    - Includes "unknown" flow regime and inaccessible sites
  - Non-perennial
    - Includes non-perennial constructed channels
  - Other (Not a stream or river):
    - Map errors, impoundments, wetlands, tidally influenced, pipelines
- Compute site "weightings"
- Compute estimated lengths, percentages, and confidence intervals

Site Evaluation Questions

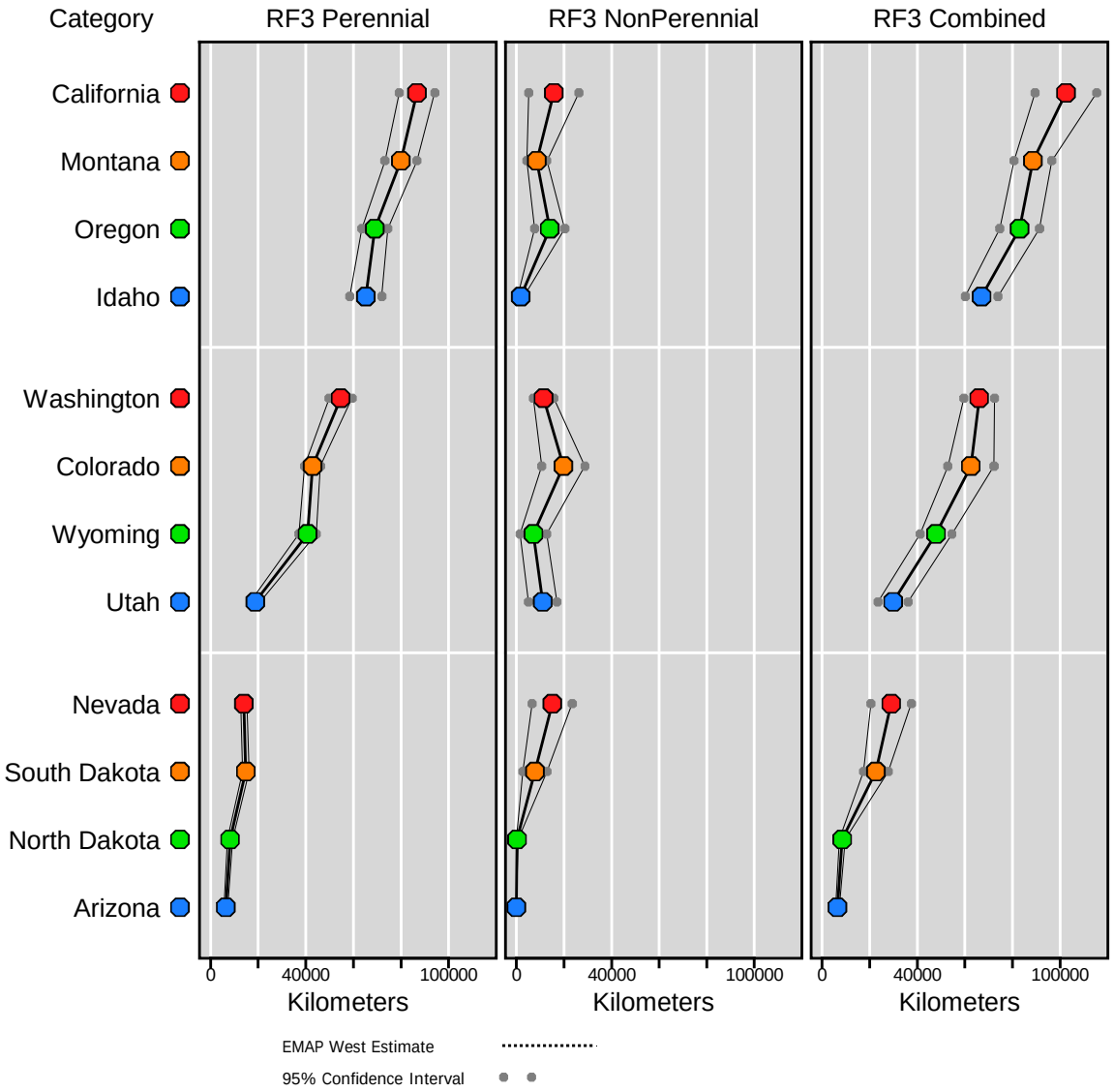
- How many kilometers of streams and rivers are “perennial” and non-perennial overall and by state?
- How many kilometers of “perennial” streams are estimated as being coded non-perennial in RF3?
- What percent of RF3 streams coded as perennial are “perennial”?

EMAP-West Stream/river Length (km ± 95% CI)

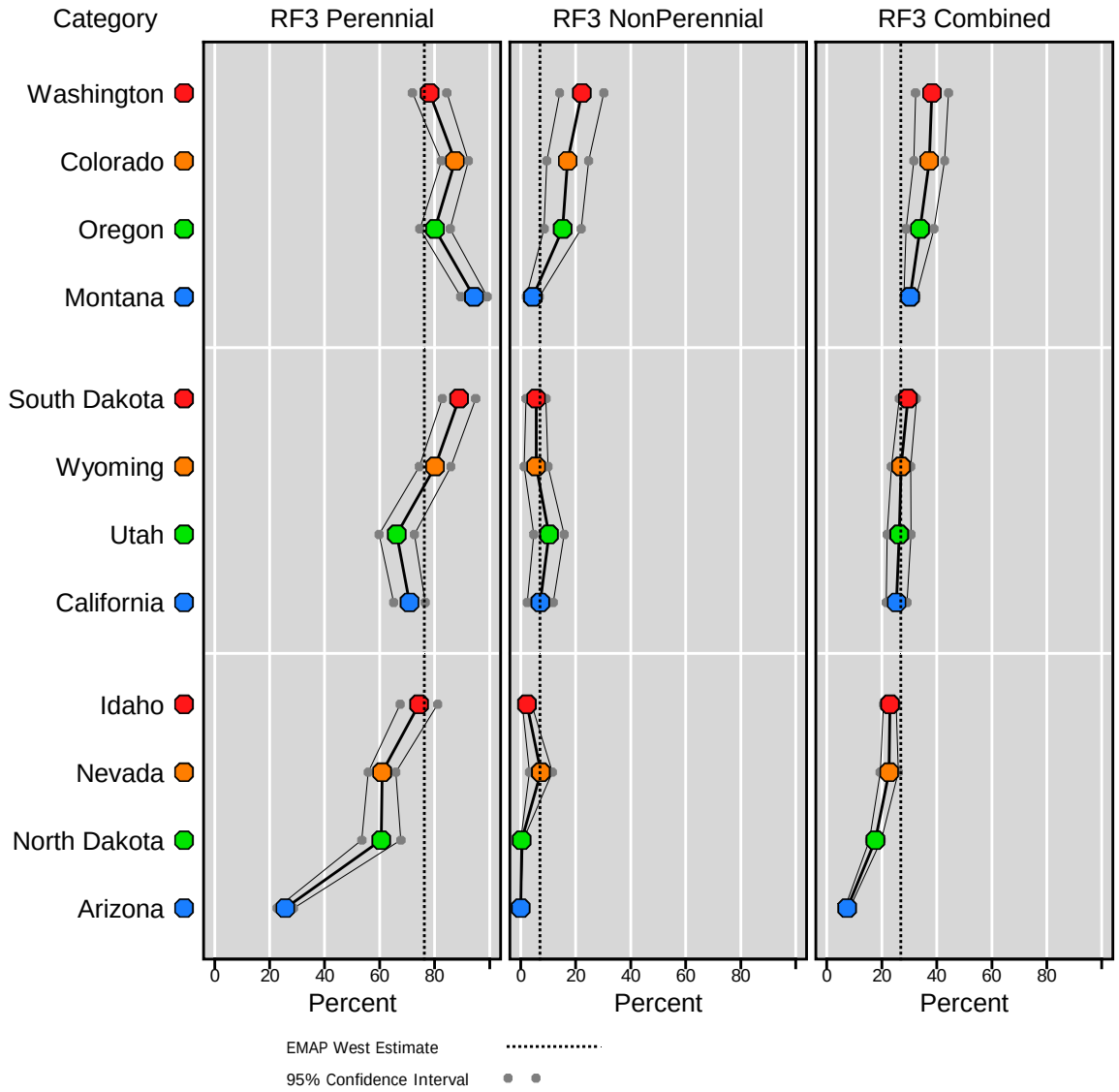
Frame Source	RF3 Frame Size	Evaluated "Perennial"	Evaluated Non-perennial
RF3 Coded Perennial (Perennial Survey)	656,706	501,060 ±15,590	128,328 ±12,709
RF3 Coded Non-perennial (Non-perennial Survey)	1,628,980	112,537 ±21,278	1,469,277 ±63,515
Total	2,285,686	613,597 ±26,378	1,597,605 ±64,774

EMAP West RF3 Site Evaluation Study

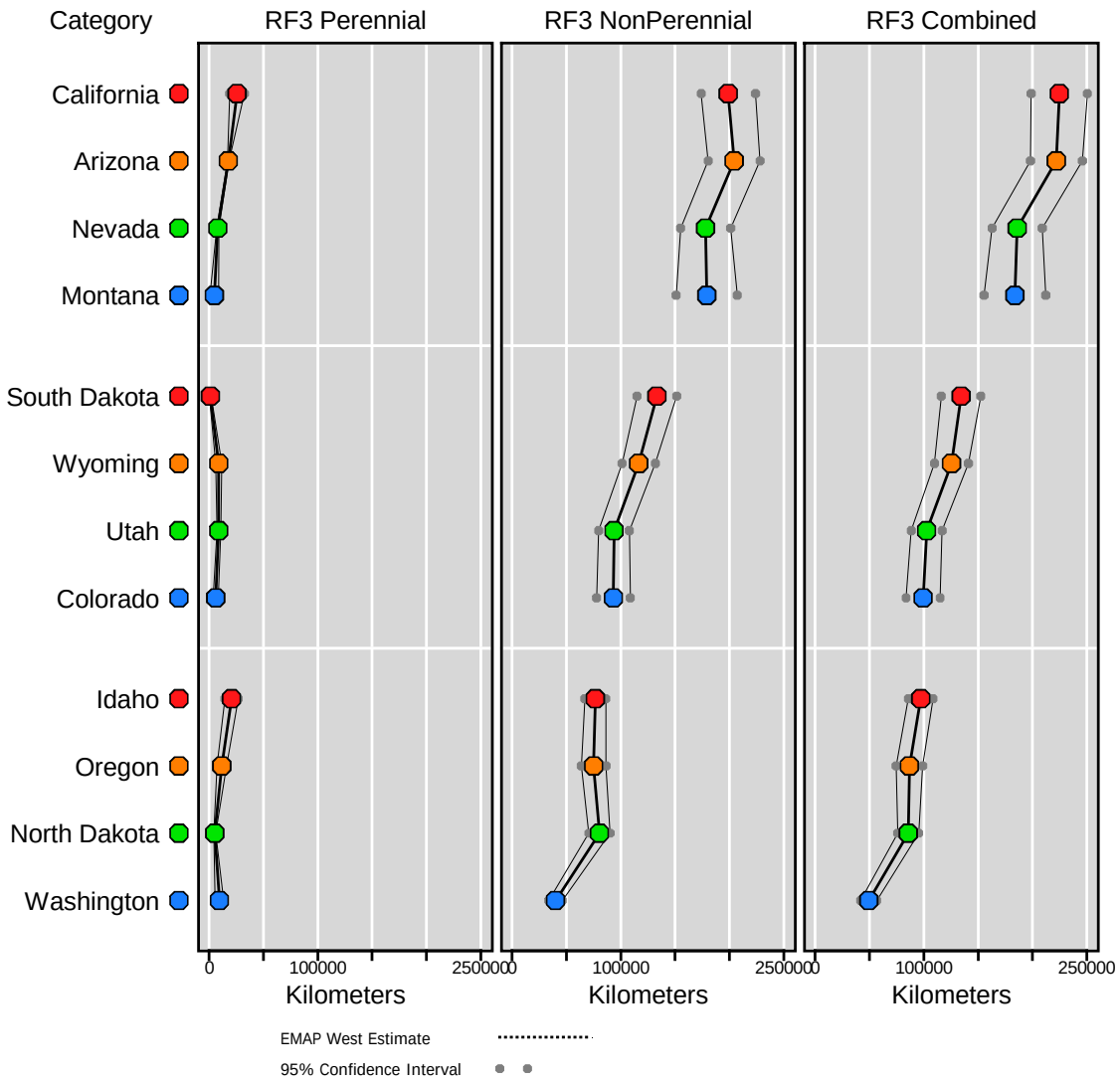
Evaluated as Perennial



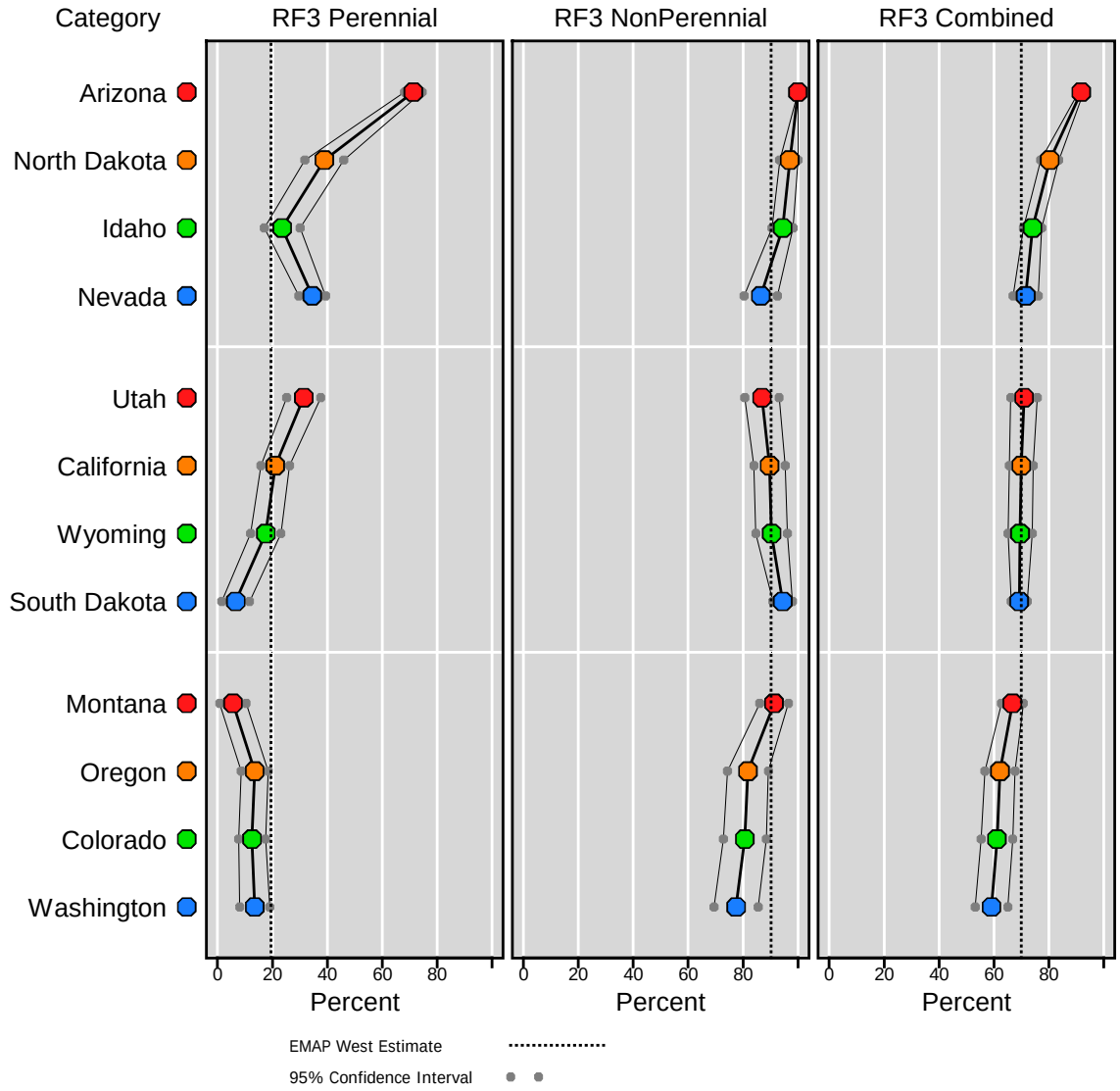
EMAP West RF3 Study
Evaluated as Perennial



EMAP West RF3 Site Evaluation Study
Evaluated as Non-Perennial

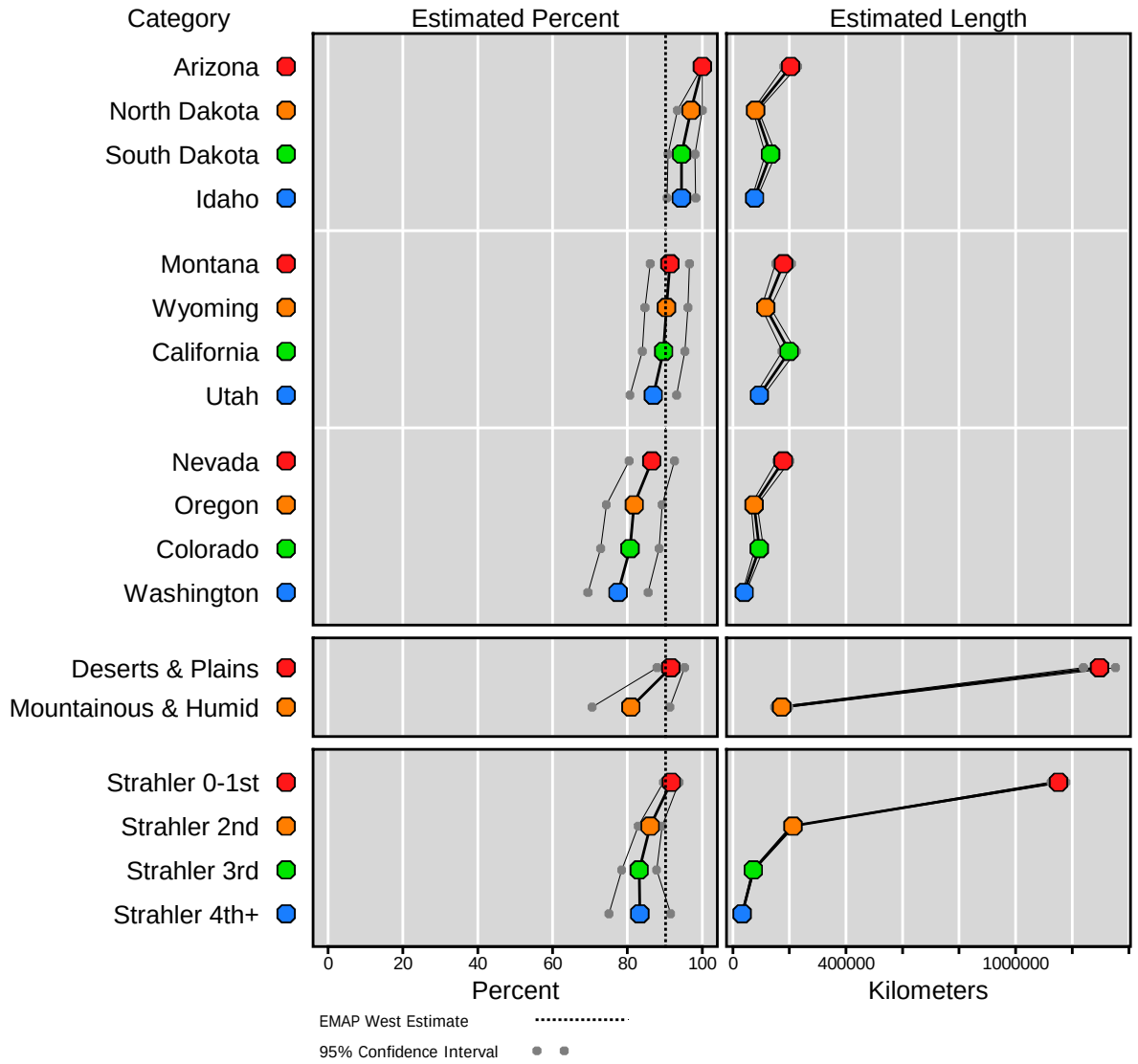


EMAP West RF3 Study
Evaluated as Non-Perennial



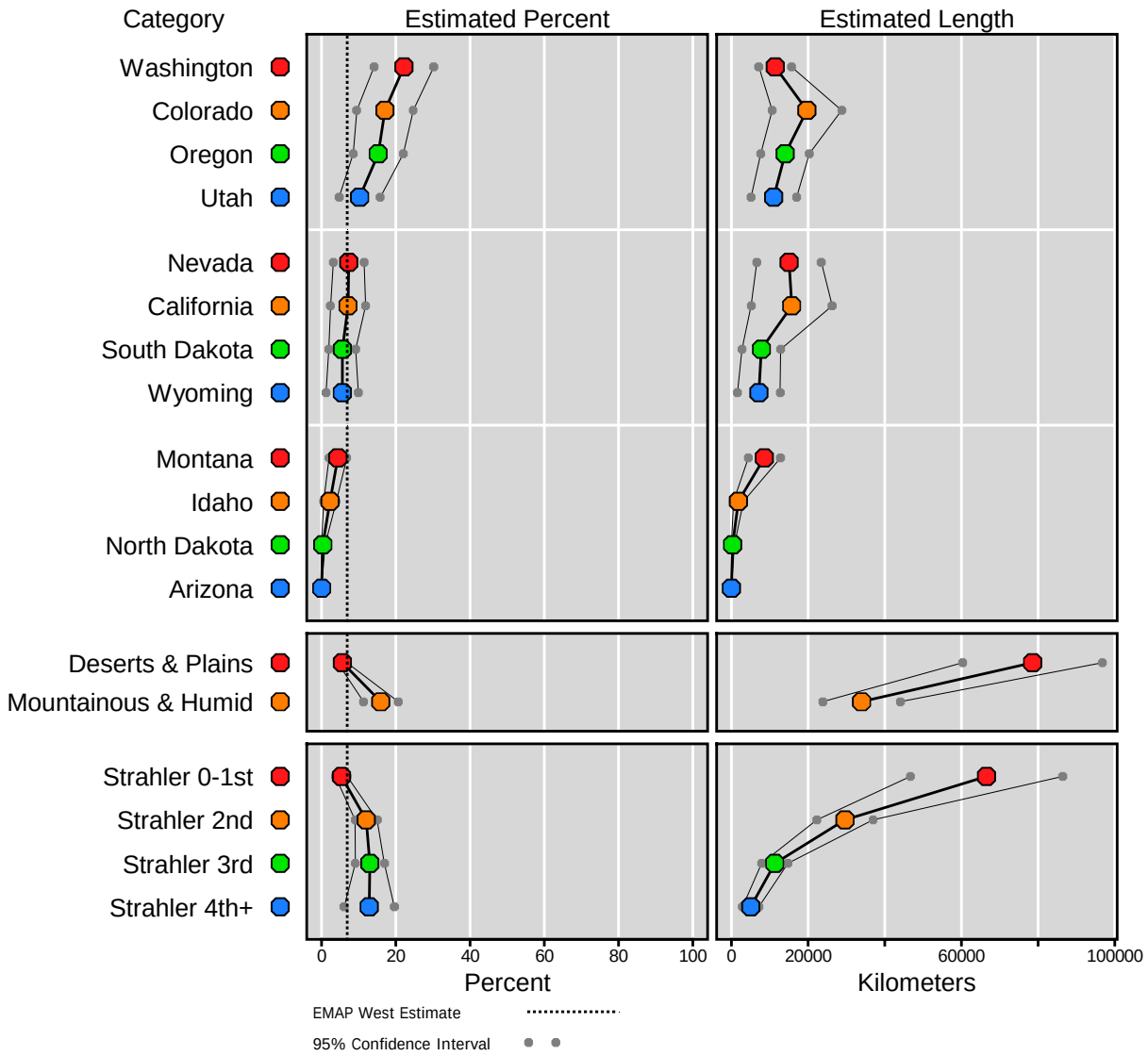
EMAP West RF3 Non Perennial Study

RF3 Non-Perennial Evaluated as Non-Perennial



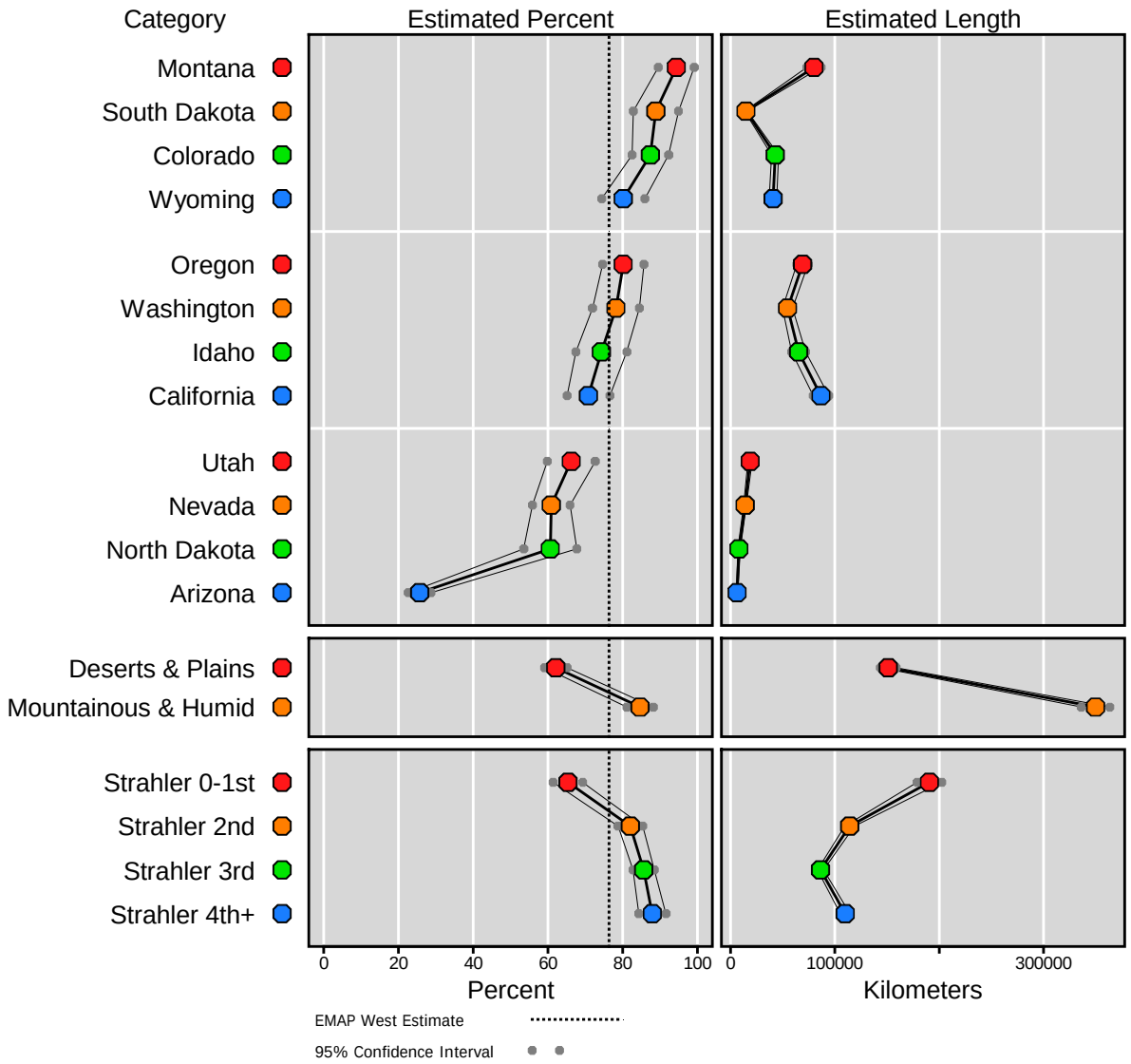
EMAP West RF3 Non Perennial Study

RF3 Non-Perennial Evaluated as Perennial



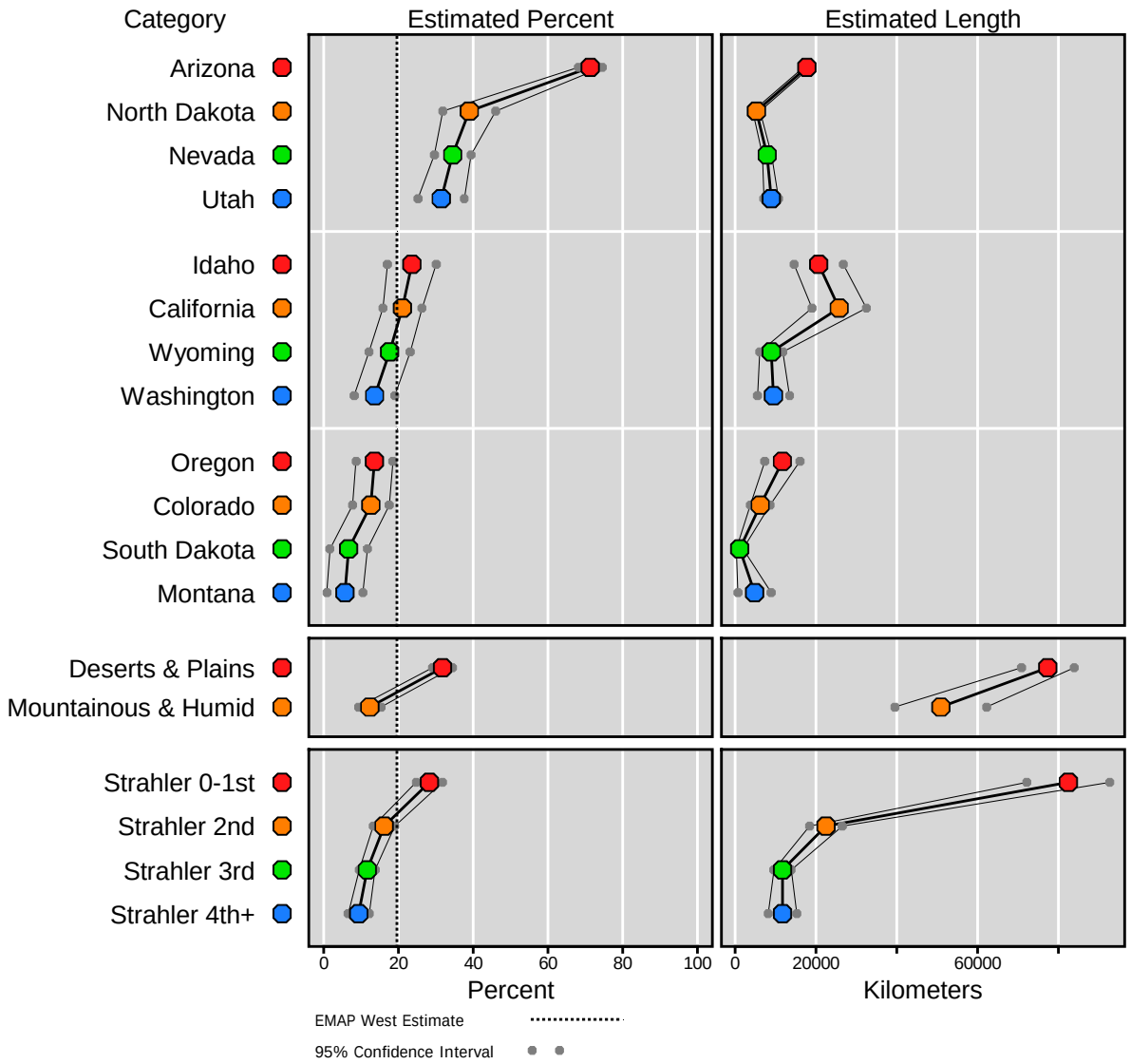
EMAP West RF3 Perennial Study

RF3 Perennial Evaluated as Perennial



EMAP West RF3 Perennial Study

RF3 Perennial Evaluated as Non-Perennial



Findings

- RF3 Non-perennial survey
  - "Perennial" sites represent overlooked portion of sample for EMAP-West: 112,000 km (18%)
- RF3 Perennial survey
  - Extra Recon effort needed to find "perennial" sites: 24% not "perennial"
- Overall
  - Have refined estimates of target population
  - Will be further refined after field reconnaissance and field sampling
    - Inaccessible sites (physical barriers, access denials)
    - More nonperennial sites
    - Other perennial sites not of interest

Implications

- Impacts stream and river lengths for 305b Reports (?)
- RF3/NHD coding for perennial requires care when used.
  - Are there areas or attributes associated with "differences" from RF3/NHD that can assist with review and possible correction?
- Information from study can be used to improve future survey designs for states